FINAL AMENDMENT
REVISED DRAFT FEASIBILITY STUDY REPORT
SANGAMO-WESTON/TWELVE MILE CREEK/LAKE HARTWELL
PCB CONTAMINATION SITE
Pickens, South Carolina

I. **EPA Comment #50**

A. EPA comment and **FINAL DECISION** - Page 4-19, Second paragraph - Delete existing language and add the following:

The US EPA Guidance on Remedial Actions for Contaminated Groundwater of Superfund Sites, December 1988, discusses the difficulty associated with treatment in certain situations. These situations may include locations where fractured bedrock occurs, where soil permeabilities are low or where dense nonaqueous phase liquids (DNAPLs) are present.

Section 121(b)(1) of the Superfund Amendments and Reauthorization Act of 1986 states that "Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal element, are to be preferred over remedial actions not involving such treatment".

The remedial action objective of groundwater recovery at this site is to contain or control migration of an identified contaminant plume. Conditions at this site may increase the complexity of such a design.

EPA Comments 65, 90, and 91

II.A. EPA comment - Page 6.7-1, Second paragraph from bottom, beginning "...Even though ground water..." - Delete existing language to end of discussion on page 6.7-4.

B. Original Language in revised draft Feasibility Study report submitted by Sangamo:

Even though ground water remediation is proposed in this alternative, hydraulic characteristics of the bedrock fracture system at the Plant and saprolite at the Breazeale and Dodgens sites indicate that results of such efforts in bedrock are highly unpredictable and that pumping from saprolite with low hydraulic conductivity may be ineffective. Hydrogeologists at EPA believe that while effectively pumping groundwater at these locations may be difficult, it is feasible.

Because of the nature of bedrock at the Plant, the uncertainties of specific ground water flow within the joint and fracture system cannot be resolved with currently available technology.

Joint and fracture systems are not always interconnected. Therefore, it is possible to install two adjacent wells, and have one produce water when pumped while the other remains dry. Recovery wells installed in either solid bedrock or unaffected fracture systems would not contribute to overall ground water restoration.

Professional technical opinion is divided about the potential effectiveness of pumping ground water for remediation at sites where water is affected by waste constituents in fractured bedrock. EPA reports that one such site in remediation under its guidance has shown promising results during the first six months of pumping. No long-term data from the site are available.

As formulated for this alternative, ground water would be collected the the extent possible by use of recovery wells. Recovery wells would be installed downgradient of the sites. By pumping each well, an effort would be made to create a hydraulic barrier. In permeable, hydraulically homogeneous aquifers, development of hydraulic barriers is often attempted. In fractured bedrock, where all flow paths are not connected and are difficult to map, and where the effectiveness of recovery wells varies, these hydraulic barriers are not considered feasible.

Where pumping of individual recovery wells is successful in removing affected ground water, it accelerates the natural flow rate of relatively clean water from areas upgradient of the constituent source through the affected areas.

C. FINAL DECISION

Hydraulic characteristics of the bedrock fracture system at the Plant and saprolite at the Breazeale and Dodgens sites indicate that results of groundwater remediation in bedrock and saprolite are highly unpredictable. Hydrogeologists at EPA believe that while effectively pumping groundwater at these locations may be difficult, it is feasible.

As formulated for this alternative, ground water would be collected by use of recovery wells. Recovery wells would be installed downgradient of the sites. By pumping each well, an effort would be made to create a hydraulic barrier. Where pumping of individual recovery wells is successful in removing affected ground water, it accelerates the natural flow rate of relatively clean water from areas upgradient of the constituent source through the affected areas.

Because of the nature of bedrock at the Plant, the uncertainties of specific ground water flow within the joint and fracture system cannot be readily resolved. Joint and fracture systems are not always interconnected. Professional technical opinion is divided about the potential effectiveness of pumping ground water for remediation at sites where water is affected by waste constituents in fractured bedrock. EPA reports that one such site in remediation under its guidance has shown promising results during the first six months of pumping. No long-term data from the site are available.

III.A. EPA comment - Page 6.7-4, Sangamo Plant Site, Replace the first paragraph with the following:

Ground water at the Sangamo Plant site occurs within the joint and fracture system of the bedrock. Ground water flow within the bedrock at the Sangamo Plant site is limited by the size orientation, and interconnection of open joints and fractures and is not homogeneous. Wells installed to establish a hydraulic barrier would be based on a detailed design developed after further aquifer testing. Ground water discharge from wells surrounding the ridge would contain primarily VOCs. This water would be treated by air stripping. Ground water downgradient of areas A, B, E, and the wastewater treatment facility would be treated by carbon adsorption. In this area, RI data showed PCBs in groundwater collected from 10 of 17 wells. VOCs have been detected in a majority of these wells. Treated water will be discharged into Town Creek.

B. Original Language in revised draft Feasibility Study report submitted by Sangamo:

Ground water at the Sangamo Plant site primarily occurs within the joint and fracture system of the bedrock. Ground water flow within the bedrock at the Sangamo Plant site is limited by the size, orientation, and interconnection of open joints and fractures, and is not homogeneous. Therefore, any estimated number of wells which might be required to establish a capture zone would apply only when good interconnection of joints and fractures exists throughout the site. Because of the hydraulic characteristics of flow through fractures, and because there is no evidence that fractures and the site are hydraulically connected, it is unlikely that all ground water upgradient of the recovery wells would be captured. These wells may not remove constituents that are heavier than water. Ground water discharge from wells surrounding the ridge would contain primarily VOCs. This water would be treated by air stripping.

Ground water downgradient of areas A, B, E, and the wastewater treatment facility would be treated by carbon adsorption. In this area, RI data showed PCBs in groundwater collected from 10 of 17 wells. VOCs have been detected in a majority of these wells. If an NPDES permit can be obtained, treated water would be discharged into Town Creek.

C. **FINAL DECISION**

Ground water at the Sangamo Plant site occurs within the joint and fracture system of the bedrock. Ground water flow within the bedrock at the Sangamo Plant site is limited by the size orientation, and interconnection of open joints and fractures and is not homogeneous. Because of the hydraulic characteristics of flow through fractures, it is unlikely that all ground water upgradient of recovery wells would be captured. Ground water discharge from wells surrounding the ridge would contain primarily VOCs. This water would be treated by air stripping. Ground water downgradient of areas A, B, E, and the wastewater treatment facility would be treated by carbon adsorption. In this area, RI data showed PCBs in groundwater collected from 10 of 17 wells. VOCs have been detected in a majority of these wells. Treated water will be discharged into Town Creek.

IV.A. EPA comment - Page 6.7-7, Implementability, 1st paragraph, last sentence - Change "impossible" to "difficult".

B. Original Language in revised draft Feasibility Study report submitted by Sangamo:

It would be impossible to locate all, if any, of the low points and extract these compounds with recovery wells.

C. **FINAL DECISION**

It would be impossible to locate all of the low points and extract these compounds with recovery wells.

V.A. EPA comment - Page 6.7-7, third paragraph - Delete the following sentence: "Fractures in bedrock that show no evidence of interconnection dramatically lower the probability of success for any groundwater collection system."

B. Original Language in revised draft Feasibility Study report submitted by Sangamo:

Ground water recovery and treatment technologies have well documented records of technical feasibility at sites underlain by homogeneous strata. This is not the case at the Plant site. Fractures in bedrock that show no evidence of interconnection dramatically lower the probability of success for any ground water collection system. Pumping tests would be completed at the Plant, Dodgens, and Breazeale sites to evaluate technical feasibility in specific locations. Because of irregular fracture patterns in the bedrock, pumping test results in one location do not imply similar implementability at another nearby location. At all location sites, an NPDES permit for discharge would have to be obtained prior to ground water collection and treatment.

C. **FINAL DECISION**

Ground water recovery and treatment technologies have well documented records of technical feasibility at sites underlain by homogeneous strata. If fractures in bedrock show no evidence of interconnection this would lower the efficiency of any ground water collection system. Pumping tests would be completed at the Plant, Dodgens, Cross Roads and Breazeale sites to evaluate ground water collection efficiencies in specific locations. Because of irregular fracture patterns in the bedrock, pumping test results in one location do not imply similar implementability at another nearby location.

VI. EPA comment and **FINAL DECISION** - Page 6.14-14, Table 6-2, Alternative 6.7, Implementability- Delete second bullet. Delete sixth bullet. Delete last bullet.